Locating tsunami warning buoys

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Australian researchers describe a mathematical model in the *International Journal of Operational Research* that can find the ten optimal sites at which tsunami detection buoys and sea-level monitors should be installed. The model could save time and money in the installation of a detection system as well as providing warning for the maximum number of people should a potentially devastating tsunami occur again in the Indian Ocean.

A magnitude 9.3 shook the sea floor off the coast of Aceh, in northern Sumatra, Indonesia, on 26 December 2004. The quake led to an overwhelming tsunami with waves as high as 10.5 m travelling at up to 8 m per second. Within two hours the tsunami had reached Colombo, in Sri Lanka and then the east coast of India. Almost eight hours later, fishing villages on the east coast of Africa in Kenya and Somalia felt its impact. There was no warning for the people affected and almost a quarter of a million lives were lost across eleven nations fringing the Indian Ocean.

In 2005, the first steps to install a tsunami warning system in the Indian Ocean were being taken, with plans to deploy 24 tsunami detection buoys. The author of the study, Layna Groen and Lindsay Botten of the Department of Mathematical Sciences, at the University of Technology, and Katerina Blazek previously at Sinclair Knight Merz, in Sydney, NSW, Australia, suggest that their model has significant implications for the construction and maintenance of the tsunami warning system in the Indian Ocean.

The Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific and Cultural Organisation (UNESCO) planned the establishment of the Indian Ocean Tsunami Warning and Mitigation System (IOTWS). The detection/alert system is the crucial component consisting of seismic detectors, sea-level monitors and deep-sea pressure sensors attached to deep ocean buoys.

Groen and colleagues have focused on the latter two components as being critical to an adequate warning system. They point out that relatively few detection buoys are yet in place and a number of sea-level monitoring stations are still to be constructed. Their study, which uses the well-known modeling tool "Mathematica", should help the IOTWS decision makers in determining where the remaining buoys should be placed.

The team's analysis supports the positioning of the 40 proposed buoys, but points out that just 1o buoys would be adequate for warning the maximum number of people. They add that the same mathematical modeling approach could be applied to tsunami detection in the Atlantic Ocean, the Mediterranean, Caribbean, and Black Seas.

"The imperative for this is made clear in the UNESCO Intergovernmental Oceanographic Committee estimate that 'by the year 2025, three-quarters of the world's population will be living in coastal areas', and 'The expanded tsunami network that the Intergovernmental Oceanographic Commission of UNESCO is coordinating is just the first step in building a global tsunami warning system designed to monitor oceans and seas everywhere'."

More information: "Optimizing the location of tsunami detection buoys and sea-level monitors in the Indian Ocean" in Int. J. Operational Research, 2010, 8, 174-188

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